

APPENDIX B

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US 6,584,443



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Kawamura et al.

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- Title: Apparatus and method for audio data/audio-related information transfer

(54) APPARATUS AND METHOD FOR AUDIO DATA/AUDIO-RELATED INFORMATION TRANSFER

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(22) Filed: Apr. 20, 2000

(30) Foreign Application Priority Data

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Apr. 4, 2000 (JP) 2000-102883

(51) Int. Cl.: G10L 19/00

(52) U.S. Cl.: 704/500, 704/501; 704/502;

704/503; 704/504

(58) Field of Search: 704/200, 500,

704/501, 502, 503, 504; 375/240

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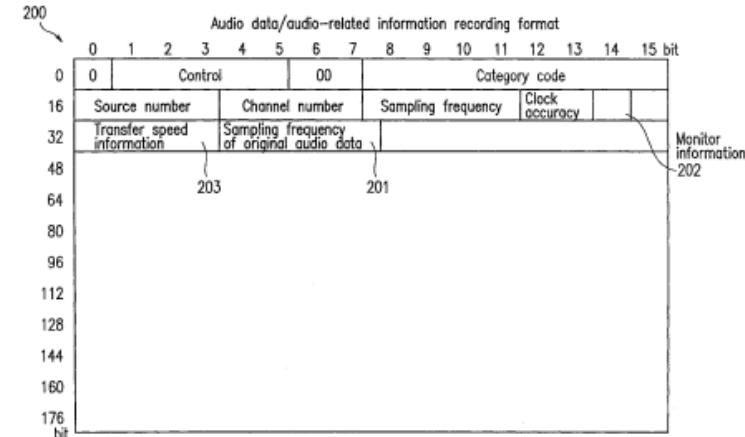
Primary Examiner—Susan McFadden

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(57) ABSTRACT

A method for transferring audio data and audio-related information includes generating second audio data from first audio data, transmitting second audio data and audio-related information associated with the second audio data, and receiving the second audio data and audio-related information which includes information on a sampling frequency of the first audio data.

27 Claims, 6 Drawing Sheets



| Claim 7 | VESA Embedded DisplayPort Standard v1.3/VESA DisplayPort Standard v1.2 |
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| 7. A method for transferring audio data and audio-related information , comprising: | <p>2.2 eDP Support by Source and Sink Components</p> <p>Except where otherwise described in this document, an <u>eDP Source</u> and <u>Sink</u> device must be fully compatible with the <u>DisplayPort 1.2 Standard</u>. Typically only one or two Main Link lanes will be needed due to the limited panel resolution normal for embedded application. The eDP Sink device must support Fast Link Training, and support of Fast Link Training by the Source device is an implementation option.</p> <p style="text-align: center;"><VESA eDP Std v1.3></p> <p>2.2.5.3 <u>Audio Stream Packet</u></p> <p>Transport of an audio stream is optional. When an audio stream is transported, the Audio InfoFrame packet describing the attribute of the audio stream and Audio_TimeStamp packet must be also transported, each once per frame during the vertical blanking period of the main video stream.</p> <p>Audio_Stream packets must be sent during both horizontal and vertical blanking periods of the main video stream. During the horizontal and vertical blanking period, DisplayPort Source device must transmit an Audio_Stream Packet whenever it has enough data to form a packet and access to the Main Link to transmit the packet(s). For more information about audio transport over DisplayPort, refer to Section 2.2.5.3 and Section 6.</p> <p>2.2.1.3 Main Video Stream Data Packing</p> <p>The link layer must first steer pixel data in a pixel-within-lane manner as shown in Table 2-2.</p> <ul style="list-style-type: none">• <u>VB-ID</u> must carry the following information:<ul style="list-style-type: none">○ Whether the main video stream is in the vertical display period or the vertical blanking period.○ Whether the main video stream is in the odd field or the even field for interlaced video○ Whether the main video stream is interlaced or non-interlaced (progressive)○ Whether the BS is inserted while no video stream is being transported. The symbols transmitted over the Main Link when no video stream is active are shown in Table 2-3.○ <u>Whether to mute the audio</u> <p style="text-align: center;"><VESA DP Std v1.2></p> |

| Claim 7 | VESA DisplayPort Standard v1.2 | | | | |
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| <p>a transmission step of transmitting the audio data and audio-related information associated with the audio data; and</p> <p>a reception step of receiving the audio data and the audio-related information,</p> | <p>2.2.5.3 <u>Audio Stream Packet</u></p> <p>Transport of an audio stream is optional. When an audio stream is transported, the Audio_InfoFrame packet describing the attribute of the audio stream and Audio_TimeStamp packet must be also transported, each once per frame during the vertical blanking period of the main video stream.</p> <p>Audio_Stream packets must be sent during both horizontal and vertical blanking periods of the main video stream. During the horizontal and vertical blanking period, DisplayPort Source device must transmit an Audio_Stream Packet whenever it has enough data to form a packet and access to the Main Link to transmit the packet(s). For more information about audio transport over DisplayPort, refer to Section 2.2.5.3 and Section 6.</p> <p style="text-align: center;">Table 2-51: Header Bytes of Audio_Stream Packet</p> <table border="1" data-bbox="545 606 1710 750"> <thead> <tr> <th data-bbox="545 606 668 663">Byte#</th><th data-bbox="668 606 1710 663">Content</th></tr> </thead> <tbody> <tr> <td data-bbox="545 663 668 750">HB0</td><td data-bbox="668 663 1710 750">Secondary-data Packet ID InfoFrame packet, <u>Audio_TimeStamp</u> packet, <u>Audio_Stream</u> packet, <u>Audio_CopyManagement</u> packet, and ISRC packet must have the same Packet ID when they are associated with the same audio stream.</td></tr> </tbody> </table> <p>2.2.1.3 Main Video Stream Data Packing</p> <p>The link layer must first steer pixel data in a pixel-within-lane manner as shown in Table 2-2.</p> <ul style="list-style-type: none"> • <u>VB-ID</u> must carry the following information: <ul style="list-style-type: none"> ○ Whether the main video stream is in the vertical display period or the vertical blanking period. ○ Whether the main video stream is in the odd field or the even field for interlaced video ○ Whether the main video stream is interlaced or non-interlaced (progressive) ○ Whether the BS is inserted while no video stream is being transported. The symbols transmitted over the Main Link when no video stream is active are shown in Table 2-3. ○ <u>Whether to mute the audio</u> | Byte# | Content | HB0 | Secondary-data Packet ID InfoFrame packet, <u>Audio_TimeStamp</u> packet, <u>Audio_Stream</u> packet, <u>Audio_CopyManagement</u> packet, and ISRC packet must have the same Packet ID when they are associated with the same audio stream. |
| Byte# | Content | | | | |
| HB0 | Secondary-data Packet ID InfoFrame packet, <u>Audio_TimeStamp</u> packet, <u>Audio_Stream</u> packet, <u>Audio_CopyManagement</u> packet, and ISRC packet must have the same Packet ID when they are associated with the same audio stream. | | | | |

| Claim 7 | VESA DisplayPort Standard v1.2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| <p>a transmission step of transmitting the audio data and audio-related information associated with the audio data; and</p> <p>a reception step of receiving the audio data and the audio-related information,</p> | <p>2.2.1.5 Main Stream Attribute/Secondary-Data Packet Insertion</p> <p>The dummy stuffing data symbols during the video blanking periods (both vertical and horizontal) may be substituted either with main stream attributes data or a secondary-data packet. Both must be framed with SS and SE control symbols as shown in Figure 2-14.</p> <p style="text-align: center;">Lane 0 Lane 1 Lane 2 Lane 3</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>BS</td><td>BS</td><td>BS</td><td>BS</td></tr> <tr><td>VB-ID</td><td>VB-ID</td><td>VB-ID</td><td>VB-ID</td></tr> <tr><td>Mvid7:0</td><td>Mvid7:0</td><td>Mvid7:0</td><td>Mvid7:0</td></tr> <tr><td>Maud7:0</td><td>Maud7:0</td><td>Maud7:0</td><td>Maud7:0</td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> <tr><td>SS</td><td>SS</td><td>SS</td><td>SS</td></tr> <tr><td colspan="4" style="border: 2px solid red; height: 100px; background-color: yellow;">Secondary-data Packet</td></tr> <tr><td>SE</td><td>SE</td><td>SE</td><td>SE</td></tr> <tr><td>BE</td><td>BE</td><td>BE</td><td>BE</td></tr> <tr><td>Pix0</td><td>Pix1</td><td>Pix2</td><td>Pix3</td></tr> <tr><td> </td><td> </td><td> </td><td> </td></tr> </table> <p style="text-align: center;">First partial-pixels of Line N+1 →</p> <p style="text-align: center;">→ Secondary-data Packet</p> <p style="text-align: center;">Sea of dummy symbols</p> <p style="text-align: center;">Zero-padded bits</p> <p style="text-align: center;">Sea of dummy symbols</p> <p style="text-align: center;">First partial-pixels of Line N+1 →</p> <p style="text-align: center;">Caption: Figure 2-14: Secondary-Data Insertion</p> | BS | BS | BS | BS | VB-ID | VB-ID | VB-ID | VB-ID | Mvid7:0 | Mvid7:0 | Mvid7:0 | Mvid7:0 | Maud7:0 | Maud7:0 | Maud7:0 | Maud7:0 | | | | | SS | SS | SS | SS | Secondary-data Packet | | | | SE | SE | SE | SE | BE | BE | BE | BE | Pix0 | Pix1 | Pix2 | Pix3 | | | | |
| BS | BS | BS | BS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| VB-ID | VB-ID | VB-ID | VB-ID | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mvid7:0 | Mvid7:0 | Mvid7:0 | Mvid7:0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Maud7:0 | Maud7:0 | Maud7:0 | Maud7:0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SS | SS | SS | SS | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Secondary-data Packet | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SE | SE | SE | SE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| BE | BE | BE | BE | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pix0 | Pix1 | Pix2 | Pix3 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

| Claim 7 | VESA DisplayPort Standard v1.2 | | | | | | | | | | | | | | | | | | | | | | | | |
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| <p>wherein the audio-related information includes monitor information indicating whether or not the audio data is capable of being monitored in the reception step.</p> | <p>2.2.1.3 Main Video Stream Data Packing The link layer must first steer pixel data in a pixel-within-lane manner as shown in Table 2-2.</p> <ul style="list-style-type: none"> • <u>VB-ID</u> must carry the following information: <ul style="list-style-type: none"> ○ Whether the main video stream is in the vertical display period or the vertical blanking period. ○ Whether the main video stream is in the odd field or the even field for interlaced video ○ Whether the main video stream is interlaced or non-interlaced (progressive) ○ Whether the BS is inserted while no video stream is being transported. The symbols transmitted over the Main Link when no video stream is active are shown in Table 2-3. ○ Whether to mute the audio <p style="text-align: center;">Table 2-3: VB-ID Bit Definition</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th data-bbox="731 717 827 745">VB-ID Bit</th><th data-bbox="827 717 1038 745">Bit Name</th><th data-bbox="1038 717 1532 745">Bit Definition</th></tr> </thead> <tbody> <tr> <td data-bbox="731 745 827 918">Bit 0</td><td data-bbox="827 745 1038 918">VerticalBlanking_Flag</td><td data-bbox="1038 745 1532 918"> <p>This bit must be set to 1 at the end of the last active line of a video frame and stay 1 during the vertical blanking period. A Source device may clear this bit in the VB-ID either immediately prior to the first active line of a video frame (that is, the first BE of a video frame) or immediately after the first active line (that is, the first BS ending the first active line of a video frame). A Sink device must be able to handle either case.</p> <p>This bit is also set to 1 when there is no video stream (as indicated by bit 3 set to 1).</p> </td></tr> <tr> <td data-bbox="731 918 827 1062">Bit 1</td><td data-bbox="827 918 1038 1062">FieldID_Flag</td><td data-bbox="1038 918 1532 1062"> <p>This bit must be set to: 0 right after the last active line in the top field. 1 right after the last active line of the bottom field. Refer to 2.2.4.2 for definitions of the top and bottom fields. For progressive (non-interlaced) video there is no bottom video and this bit remains 0.</p> </td></tr> <tr> <td data-bbox="731 1062 827 1134">Bit 2</td><td data-bbox="827 1062 1038 1134">Interlace_Flag</td><td data-bbox="1038 1062 1532 1134"> <p>This bit must be set to 1 when the main stream is an interlaced video. For non-interlaced video or no video, this bit must stay 0.</p> </td></tr> <tr> <td data-bbox="731 1134 827 1206">Bit 3</td><td data-bbox="827 1134 1038 1206">NoVideoStream_Flag</td><td data-bbox="1038 1134 1532 1206"> <p>This bit must be set to 1 when preceding BS is inserted while no video stream is transported. When this bit = 1, the Mvid 7:0 value must be “don’t care.”</p> <p>Note: An audio stream may be transported even when no main video stream is being transported.</p> </td></tr> <tr> <td data-bbox="731 1206 827 1235">Bit 4</td><td data-bbox="827 1206 1038 1235">AudioMute_Flag</td><td data-bbox="1038 1206 1532 1235"> <p>This bit must be set to 1 when the audio is to be muted.</p> </td></tr> <tr> <td data-bbox="731 1235 827 1293">Bit 5</td><td data-bbox="827 1235 1038 1293">HDCP SYNC DETECT</td><td data-bbox="1038 1235 1532 1293"> <p>Used by HDCP capable DisplayPort uPacket RXs to detect the CP lock status.</p> <p>Refer to HDCP Specification 1.3 – Amendment for DisplayPort</p> </td></tr> <tr> <td data-bbox="731 1293 827 1321">Bits 7:6</td><td data-bbox="827 1293 1038 1321">RESERVED</td><td data-bbox="1038 1293 1532 1321">RESERVED (All 0s)</td></tr> </tbody> </table> | VB-ID Bit | Bit Name | Bit Definition | Bit 0 | VerticalBlanking_Flag | <p>This bit must be set to 1 at the end of the last active line of a video frame and stay 1 during the vertical blanking period. A Source device may clear this bit in the VB-ID either immediately prior to the first active line of a video frame (that is, the first BE of a video frame) or immediately after the first active line (that is, the first BS ending the first active line of a video frame). A Sink device must be able to handle either case.</p> <p>This bit is also set to 1 when there is no video stream (as indicated by bit 3 set to 1).</p> | Bit 1 | FieldID_Flag | <p>This bit must be set to: 0 right after the last active line in the top field. 1 right after the last active line of the bottom field. Refer to 2.2.4.2 for definitions of the top and bottom fields. For progressive (non-interlaced) video there is no bottom video and this bit remains 0.</p> | Bit 2 | Interlace_Flag | <p>This bit must be set to 1 when the main stream is an interlaced video. For non-interlaced video or no video, this bit must stay 0.</p> | Bit 3 | NoVideoStream_Flag | <p>This bit must be set to 1 when preceding BS is inserted while no video stream is transported. When this bit = 1, the Mvid 7:0 value must be “don’t care.”</p> <p>Note: An audio stream may be transported even when no main video stream is being transported.</p> | Bit 4 | AudioMute_Flag | <p>This bit must be set to 1 when the audio is to be muted.</p> | Bit 5 | HDCP SYNC DETECT | <p>Used by HDCP capable DisplayPort uPacket RXs to detect the CP lock status.</p> <p>Refer to HDCP Specification 1.3 – Amendment for DisplayPort</p> | Bits 7:6 | RESERVED | RESERVED (All 0s) |
| VB-ID Bit | Bit Name | Bit Definition | | | | | | | | | | | | | | | | | | | | | | | |
| Bit 0 | VerticalBlanking_Flag | <p>This bit must be set to 1 at the end of the last active line of a video frame and stay 1 during the vertical blanking period. A Source device may clear this bit in the VB-ID either immediately prior to the first active line of a video frame (that is, the first BE of a video frame) or immediately after the first active line (that is, the first BS ending the first active line of a video frame). A Sink device must be able to handle either case.</p> <p>This bit is also set to 1 when there is no video stream (as indicated by bit 3 set to 1).</p> | | | | | | | | | | | | | | | | | | | | | | | |
| Bit 1 | FieldID_Flag | <p>This bit must be set to: 0 right after the last active line in the top field. 1 right after the last active line of the bottom field. Refer to 2.2.4.2 for definitions of the top and bottom fields. For progressive (non-interlaced) video there is no bottom video and this bit remains 0.</p> | | | | | | | | | | | | | | | | | | | | | | | |
| Bit 2 | Interlace_Flag | <p>This bit must be set to 1 when the main stream is an interlaced video. For non-interlaced video or no video, this bit must stay 0.</p> | | | | | | | | | | | | | | | | | | | | | | | |
| Bit 3 | NoVideoStream_Flag | <p>This bit must be set to 1 when preceding BS is inserted while no video stream is transported. When this bit = 1, the Mvid 7:0 value must be “don’t care.”</p> <p>Note: An audio stream may be transported even when no main video stream is being transported.</p> | | | | | | | | | | | | | | | | | | | | | | | |
| Bit 4 | AudioMute_Flag | <p>This bit must be set to 1 when the audio is to be muted.</p> | | | | | | | | | | | | | | | | | | | | | | | |
| Bit 5 | HDCP SYNC DETECT | <p>Used by HDCP capable DisplayPort uPacket RXs to detect the CP lock status.</p> <p>Refer to HDCP Specification 1.3 – Amendment for DisplayPort</p> | | | | | | | | | | | | | | | | | | | | | | | |
| Bits 7:6 | RESERVED | RESERVED (All 0s) | | | | | | | | | | | | | | | | | | | | | | | |

| Claim 9 | VESA DisplayPort Standard v1.2 |
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| <p>9. A method according to claim 7, further comprising a muting step of muting the audio data if the monitor information indicates that the audio data is not capable of being monitored in the reception step.</p> | <p>5.2.3.2 Audio Stream Format/Timing Change</p> <p>As for audio format/timing change, the Source device should set and keep <u>VB-ID bit 4 (AudioMute Flag)</u> to <u>a '1'</u> until after the new Audio InfoFrame and Audio_TimeStamp have been sent. An audio format change is caused by any of:</p> <ul style="list-style-type: none">• A change between the compressed and non-compressed audio• A change in the sampling rate• A change in the number of channels <p>Those packets may be sent as soon as the next frame boundary (when the main video stream is present) or after the next 512th BS symbol set (when the main video stream is absent).</p> <p><u>The Sink device must mute the audio when the AudioMute Flag is set, and should be ready to receive a new audio format upon detecting the change in Audio InfoFrame and Audio_TimeStamp packets.</u></p> |

| Claim 9 | VESA DisplayPort Standard v1.2 |
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| 9. A method according to claim 7, further comprising a muting step of muting the audio data if the monitor information indicates that the audio data is not capable of being monitored in the reception step. | <p>6.3.1 Handling of an Audio Format Change</p> <p>The transported audio format may be changed at any time. The DP transmitter should start sending an audio mute signal prior to the audio format change, by <u>setting bit 4 (AudioMute_Flag) of VB-ID which is sent once per main video stream line period (or once per 8192 link symbols when the main video stream is absent).</u> An audio format change is caused by any of:</p> <ul style="list-style-type: none">• A change between the compressed and non-compressed audio• A change in the sampling rate• A change in the number of channels <p>This signal indicates to the DP receiver that the audio system is in a transient process and the audio stream may be not valid at this time. <u>When the AudioMute Flag is '1', a DP receiver must disable its audio output while continuing to receive and process Audio Time-stamps.</u></p> <p>The DP transmitter should clear the AudioMute_Flag to '0' only after finishing the transient process at the audio source input, finishing audio clock measurement with a correct and stable value and providing information about this change to the receiver. The DP transmitter should clear the audio mute signal only after transferring Audio Time-stamp and Audio Info packet (if needed).</p> <p>Once the DP transmitter clears the AudioMute_Flag to '0', a DP receiver should enable its audio output only after the regenerated audio clock becomes stable and after it has collected enough audio status information.</p> |